

## **Hydrogeological analysis of combined well and open-closed loops geothermal (CWG) system**

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Usage of open-loop geothermal heat pump (GHP) system and closed-loop geothermal heat pump systems have been increased in Korea to reduce emission of greenhouse gases during decades. The advantage of the open-loop GHP system is energy-efficiency and the advantage of the closed-loop GHP system is maintenance costs. However, the open-loop GHP system requires large amount of groundwater supply and the closed-loop GHP system requires high costs of initial installation. The performance and efficiency of the GHP systems depend not only on characteristics of the GHP system itself but also on hydrogeological conditions. To overcome the disadvantages of open-loop or closed-loop GHP system, the combined well and open-closed loops geothermal (CWG) system was designed. The closed-loop GHP systems surrounds the open-loop GHP system in the CWG system. The groundwater pumped by the open-loop GHP supply the geothermal energy to closed-loop GHP systems. Lab scale tests were performed to find proper design of the CWG systems. Small aperture hybrid CWG systems and large aperture CWG systems were constructed and analyzed in the aspect of energy efficiency and hydrogeological conditions. This study was supported by the New & Renewable Energy Core Technology Program of the Korea Institute of Energy Technology Evaluation and Planning (KETEP), granted financial resource from the Ministry of Trade, Industry & Energy, Republic of Korea (No.2015303011120). Also this study was supported by the Korea Ministry of Environment as "The GAIA project".